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The ILLUMINATING ENGINEER

ELECTRICITY · ACETYLENE · OIL · GAS

Edited by LEON GASTER

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OFFICIAL ORGAN OF THE
Illuminating Engineering Society.
(Founded in London 1909.)

This number contains among others, articles on the following Subjects :—

The Preservation of the Eyesight of School Children.

The Illumination of the Panama-Pacific International Exhibition.

Some Notes on the Use of Light in Cinematograph Work.

VISIBILITY PROBLEMS IN WAR—SAFETY PRECAUTIONS AS REGARDS STREET LIGHTING IN WAR TIME—SUBMARINE PHOTOGRAPHY—THE LIGHTING OF YE OLDE MITRE TAVERN, &C.

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EDITORIAL.

The Organisation of Science and Invention.

During the last few weeks a series of letters by eminent men of science have appeared in *The Times* and elsewhere suggesting methods of mobilising the scientific ability and invention of the nation. The eyes of people in this country are now opened to the great possibilities of applied science, both in peace and war, and it may be hoped that fuller advantage will be taken of our resources in this respect.

We note the announcement of the formation of a Board of Inventions for the Admiralty under the Chairmanship of Lord Fisher, and we recall that Mr. Pease, in his recent review in the House of Commons, showed his appreciation of the need for better organisation of our technical resources in relation to manufacture. We believe that these views are shared by his successor, Mr. Henderson, and that the Advisory Council on Industrial

Research, when fully established in connection with his department, will do good work. Meantime, we see on all sides evidence of a willingness to help. The various scientific and technical societies throughout the country stand at the disposal of the Government. Many of the Technical Institutions are already engaged on war work; some on research, others in training men for making munitions.

The problem before us is to organise this vast mass of willing labour. The great need at the present moment is *to secure co-operation, and prevent overlapping*. The existing technical staffs of the various Government departments are naturally fully occupied with the extra routine work arising through the war. Efficient outside assistance should therefore be of service in dealing with the enormous number of novel problems that require urgent solution.

We venture to suggest a few possible methods of co-operation. Following the National Register shortly to be prepared, we should like to see a complete Register of Technical and Scientific Ability, prepared by a suitably constituted Committee acting in conjunction with the Board of Inventions and of the Ministry of Munitions. A complete list of the various technical and scientific societies able to help in any respect could easily be compiled and the Secretaries might be asked to give a summary of the lines of work undertaken by the Society, their possible applications to the war, and the kind of assistance which they would be prepared to render. Similar particulars should be obtained from the chief Scientific and Technical Institutes, so that some of them could be used for training operators in various forms of munition work, *according to a standardised and approved course of study*, the laboratories of the Colleges devoted to more advanced work being organised for research. Scholarships might be instituted and prizes offered for work on specific subjects. A list of problems requiring solution might be prepared and submitted to those Societies or Colleges capable of dealing with them. Workshops might be taken over in various parts of the country where novel appliances could be made and experimented with; officers at the Front might be invited to forward a constant stream of suggestions as to appliances and devices which might help them in their defence against attacks of the enemy.

The Secretaries or Councils of the respective scientific and technical societies could be asked to nominate some of their members, or to form a Committee to make experiments. In the case of other questions of a more debatable nature, the problem might be handed over to certain Societies for further discussion (if necessary *in camera*).

In this way a vast amount of useful information would gradually be collected, and arranged for convenient future reference at headquarters. Nor need co-operation stop here. Many of these problems would doubtless be receiving the attention of our Allies, and a constant interchange of experience between the respective countries would be beneficial in preventing overlapping of work; certain problems might be handed over to experts in the various countries who had made the subject a life-study, or were in a particularly happy position to deal with them.

Above all, our aim in future should be to stimulate and encourage invention. A problem that was half-solved, or even a problem whose solution, though very desirable, was not apparent, should not be tossed aside, but carefully studied and developed in the hope of ultimate success.

It may be said that such a comprehensive scheme would absorb the energies of a vast army of workers and would be costly. The answer is

that a large number of the workers could be recruited from those scientific men who are at present looking in vain for an opportunity to be of service ; and that the cost, though apparently high, would be well repaid in the future. The machinery built up would not be of a temporary and transient value. It would form the basis of a vast staff of expert experience, the mobilised scientific army of the country always at its service for any future emergency. Moreover, although at present our efforts must be concentrated on bringing this war to a successful conclusion, it is obvious that such a register would be of immense value in times of peace. Side by side with the purely war work there might be presently built up a corresponding organisation which could use all this mobilised ability on industrial problems of national importance ; so that when peace arrives we could use this machine for the purpose of grappling with the vast problems of restoring our industries, finding new applications for the national resources, and investigating problems of national importance. As an indication of the possibilities in this direction we have only to study the work of the British Science Guild, which has in many cases served as a useful link between the scientist, the manufacturer and the authorities, and whose experience would doubtless be of value in preparing such a Register as that suggested above.

To turn from the general to the particular, we will take the case of our own Society. Our field is the practical application of light. We have already accumulated a great deal of information regarding lamps and lighting appliances and their applications, and in the past we have discussed many problems of national importance with which we, in conjunction with other Societies, would be prepared to deal in the nation's interests.

During the past session several subjects bearing on the war, such as the development and applications of searchlights and the lighting of rifle ranges, and various problems in connection with the visibility of distant objects, have been discussed. One could call to mind many others, such as the design of optical range-finders and signalling devices, the lighting of field hospitals and the design of special illuminating appliances used in medical work and in the trenches, the lighting of camps and barracks and the provision of all sorts of lamps and portable illuminants required at headquarters—which deserve study. We know the appliances available and the sources of supply, and from the nature of our training should be fitted to recognise their limitations and suggest modifications in design for special purpose.

Similarly, in fields less directly connected with military affairs, such as the modifications in public lighting throughout the country as a measure of safety against hostile aircraft, and the regulation of the illuminating power of motor-car head-lights, our experience should be of value. When once the connection between the *want* and the *source of information* is established many other opportunities for useful service would doubtless suggest themselves.

There must be many other societies and institutions throughout the country anxious to put their services at the disposal of the State, but their members desire some assurance that their special training and experience will be utilised wisely. From this standpoint it is vital that the National Register should be supervised by men of wide experience, and that a proper classification of the scientific and technical ability available should be made.

Problems in the Lighting of Cinematograph Studios and Theatres.

There are few industries that have made such vast strides, and in so short a time, as the moving picture industry. Large sums of money have been spent in the production of films, and in the building of special theatres, and, if we may judge from reports, this is one of the few businesses in this country which have not suffered materially through the war. For one thing the stoppage of the films from the Continent has caused manufacturers in this country to redouble their efforts ; also the war has led to the preparation of much special topical material of exceptional interest to the public.

In an article in our last issue the lighting of cinematograph studios was dealt with.* In this number we have a general article on some of the lighting problems met with in the manufacture and exhibition of films. There is a rich field here for the invention of the illuminating engineer. There is scope for great skill in the lighting of the theatre where the film is shown to the public, and also in the illumination of the studio where the film is prepared. There are two quite distinct problems. The lighting of studios in particular is undergoing constant changes owing to the introduction of new lamps and lighting appliances. We have already available, among the electrical illuminants, the mercury vapour lamp, various types of arc lamps, and the gas filled incandescent electric lamp, and the best methods of using them observe careful study. The conditions of lighting will differ according as one is aiming at the reproduction of the scene in a full daylight, candle light, firelight, &c. The perfection of the film depends upon the exactitude of exposure, and one would therefore suppose that the use of photometry in order to determine the amount of illumination available might be of service.

In the theatre we have again many interesting problems. It is well known that the efficiency of the projector as at present designed is extremely low. It has been estimated that of the light produced in the lantern, less than 1 per cent. is usefully employed on the screen ; and of the light reflected from the screen a considerable portion never reaches the eyes of the audience, and therefore fulfils no useful purpose. It is generally agreed that the arc is the best illuminant for projector work on account of its enormous intrinsic brilliancy ; yet there are other sources of light, such as the oxy-acetylene incandescent light and the half-watt lamp, which may prove to have a certain utility for the smaller types of projectors. In the choice of illuminants the avoidance of any possibility of fire would naturally be an important consideration.

Attempts have been made recently to increase the brightness of the image of the screen by receiving it on a surface composed of aluminium powder. It appears, however, that although a considerably brighter image can be obtained in this way the method has some practical disadvantages.

Finally there are other possible radical improvements such as the application of colour photography to cinematographic work. It is well known that a considerable amount of work is being done in this direction, and we have reason to believe that the prospect of success is by no means remote; some of the results already obtained are quite remarkable.

The whole subject teems with points on interest to the lighting expert, and there are few industries which offer greater rewards to the successful inventor.

LEON GASTER.

* *Illum. Eng.*, June, 1915, p. 284.

SAFEGUARDING THE EYESIGHT OF SCHOOL CHILDREN.

By M. LUCKIESH.*

THERE are stated to be 20,000,000 school children in the United States who are devoting several hours daily to study, or to other work equally trying to the eyes. According to the available statistics about 10 per cent. of the school children examined are found to have defective vision, and the percentage of defective sight rises with increasing age. Such defects constitute a great industrial handicap, and a loss in efficiency to the nation.

There is therefore every reason to study the conditions responsible for these defects and remove them. It is believed that one important contributory cause is to be found in unsatisfactory arrangements for the position of artificial light. Children reading in a poor light acquire the habit of bringing the reading matter too close to their eyes, and this process ultimately leads to near-sightedness. Glare from windows, blackboards, glazed paper or other sources of light, may also lead to eye fatigue.

Professor J. Widmark, in a paper on "Decrease of Short-Sightedness in Secondary Schools for Boys in Sweden," publishes some interesting statistics,† which are reproduced in Figs. 1 and 2.

Fig. 1 shows the distinct rise which occurs in the percentage of short-sightedness in the higher grades of work; the percentage seems to be highest in the classical schools, where, presumably, the eyes are more severely tried.

Fig. 2 shows the hopeful results obtained by careful attention to the conditions in the schools during the years 1895-1906.

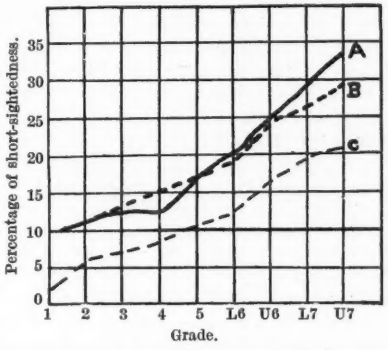


FIG. 1.—Prevalence of short-sightedness in three secondary schools in Stockholm, 1894—1903.

A—Classical school. B—Mixed school. C—Modern school.

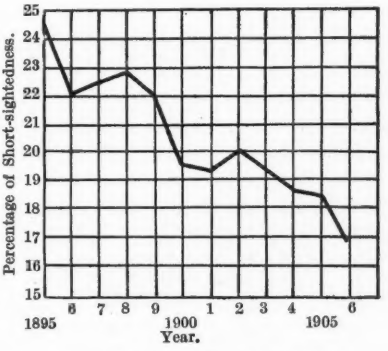


FIG. 2.—Percentage of short-sightedness in the highest class of all the State secondary schools for boys in Sweden.

* Abstract of a paper read at a meeting of the Pittsburg section of the Illuminating Engineering Society, United States of America, Cleveland, Ohio, June 29th, 1915; Transactions of the Illuminating Engineering Society, U.S.A., Vol. 10, No. 2, page 181.

† Transactions of the fourth International Congress on School Hygiene held in Buffalo, 1913.

A steady decrease in the number of cases of short-sightedness is the result. Professor Widmark accounts for this decrease as follows :—

> Among the hygienic improvements which have been affected during recent years in our schools and in all conditions relating thereto, I should be disposed to mention first the improvements in the lighting of rooms and in the printing of the books used by the pupils ; and that for this reason, among others—that the influences of these changes is of effect in the homes too, the strain on the eyes when the pupils are busy with the preparation of lessons being thereby much reduced. If a comparison is made between the methods of lighting rooms now and those of ten years ago the difference is very striking, both at school and at home.

Mr. Luckiesh proceeds to quote the views of other authorities on school lighting and the need for careful specification of the illumination in the class-room. The author suggests that the most important factors, as far as lighting is concerned, are (1) intensity of illumination, (2) uniformity of illumination, (3) direction of light, (4) absence of glare. He points out the desirability of avoiding inconvenient reflection from polished surfaces ; of recent years considerable decrease has been made in the use of polished surfaces. Glare from the sky or other light sources may give rise to after-images. The author gives a diagram showing how the duration of after-images is affected by the brightness of the surface and the time of exposure. It is possible that this test would be of some use in ascertaining those conditions which are inconvenient to the eyes.

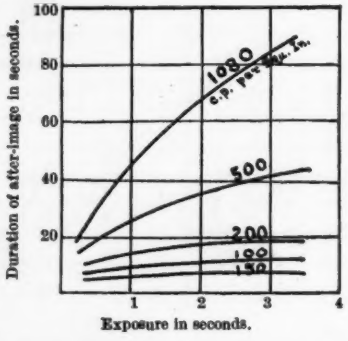


FIG. 3.—Illustrating how the duration of after-images is affected by intrinsic brilliancy and time of exposure.

Comparatively little work has yet been done showing the direct influence of glare on acuteness of vision. Mr. Luckiesh points out the need for extending such experiments for a considerable period, since the effect of glare is cumulative. It is only after a person has been working for a considerable time, that the fatigue of the eyes becomes evident. Mr. Luckiesh gives an account of some experiments showing that the glare from the blue sky gave rise to a diminution in visual acuity from 1·2 to ·8 during about 15 minutes. He also found that by using special yellow-green glasses absorbing 50 per cent. of light, the diminution was much less. The following are the chief conclusions he draws from his experiments :—

(1) Glare conditions are not always apparent when the eyes are not engaged in serious work such as reading or distinguishing fine detail. However, bad lighting conditions are readily recognised when the eyes are called upon to do such work.

(2) There is a rapid falling off of visua acuity when the conditions of glare are severe.

(3) Such harmless appearing light sources as a wide expanse of sky can produce a very severe condition of glare. The intrinsic brightness is very low as compared with artificial sources, but the quantity of light is high and the image of the sky is spread over a large portion of the retina.

(4) There was an apparent recuperation of the eye during the periods that the yellow-green glasses were worn.

(5) Notwithstanding the effect of glare, when clear glasses were worn, in reducing visual acuity the values of the latter when the coloured glasses were worn remained considerably higher.

(6) This experiment emphasises the necessity of prolonging acuity readings over a considerable period if acuity is to be a criterion of the satisfactoriness of illumination conditions.

In the concluding portion of his paper Mr. Luckiesh gave a summary of the legislation of school lighting (both natural and artificial) in various States. From the study of these and also results of experiments made by a recently appointed

committee of the Illuminating Engineering Society in the United States, he makes the following chief suggestions :—

GENERAL CONSIDERATIONS.

The lighting of a school building should be referred to a competent expert before the plans for the building are drawn. The importance of doing this early is evidenced by the fact that the orientation of the building plays an important part in the design of those features which depend for their satisfactoriness upon proper lighting.

Minimum intensity of illumination, 2·5 to 3·0 foot-candles on the plane of the desk top.

Polished surfaces such as blackboards, glossy paper, polished desk tops, and glazed walls should be avoided.

Light sources (sky or artificial) should be well out of the ordinary visual field.

Glare from blackboards should be avoided. This can be done by carefully placing them, by lighting artificially, by tilting them, and by keeping their surfaces matt. They should never be placed between windows.

Excessive brightness contrasts should be avoided. A bright source should not be viewed against a dark background. The walls adjacent to a blackboard should not be too light in colour.

Surroundings such as walls and ceilings should in general be light in colour. Ceilings and frieze should be practically white (high reflecting power). Walls should be reasonably light. Colours used should be white, grey or tints of buff, cream, or olive green.

Children should be taught to safeguard their vision ; that is, how to hold their books, to assume a correct position relative to the light source, to complain of glare from blackboards, &c.

Teachers should be instructed to teach fundamentals to the children.

Good lighting should be incorporated in every course where practicable and especially in the " home-making " course.

MORE SPECIFIC RECOMMENDATIONS.

Natural lighting—Window area should be ample—that is, an appreciable percentage (say at least 20 per cent.) of the floor area.

The windows should preferably be located on one side of the room to the left of the students.

A portion of the sky should be visible from every desk top at least 5 degrees vertically.

The width of the room should not be more than twice the window height.

The windows should be equipped with approved window shades for controlling the light and excluding direct sunlight.

Prism glass should be used in extreme conditions at least.

Lighting and ventilating courts should be painted white.

Minimum illumination on desk top, 3 foot-candles.

Diversity of illumination not greater than 100 to 1.

Artificial Lighting.—Ample general lighting is recommended. Local units subject to control of pupils are condemned.

Minimum illumination on desk top, 2·5 foot-candles.

Light sources should be out of normal visual field if possible. They should be equipped with diffusing glassware to reduce their brightness and screen the source from the pupils.

Highest permissible brightness, 3 candlepower per square inch when viewed against a light background.

Blackboards should be lighted by properly screened and judiciously placed local units.

The system of lighting will depend upon many conditions. Any well-designed system is satisfactory in its proper place. There appears to be a growing tendency to use the semi-direct system, which appears more generally satisfactory for class rooms, reading rooms, &c. In the shops a direct system is advisable.

No local units should be used unless absolutely necessary.

We are glad to note that the Illuminating Engineering Society in the United States is endeavouring to co-operate with school authorities in bringing about improvements in the lighting of schoolrooms. The paper is concluded by a Bibliography in which the recent data obtained by the Illuminating Engineering Society in this country are given.

DIMINISHED ILLUMINATION AND ACCIDENTS IN THE STREETS.

The Annual Report of the Coroner for the City of London and the Borough of Southwark, Dr. F. J. Waldo, makes some interesting references to the increased number of fatal accidents that have occurred in that district, during the latter months of 1914.

It is pointed out that on the whole the number of traffic deaths have decreased during the past two years. During the latter part of 1914, however, there was a significant *increase*. During 1914 these were seven deaths in the period January-March, nine from July to September, and twenty-one during October, November and December.

The Report comments on these figures as follows :—

"The only condition peculiar to the year under report is the fact that, owing to the European War now raging, the streets and bridges have, for protective purposes, been darkened during the last three months of the year. In other words, the increased traffic fatality corresponds with the darkening of the streets. In further analysing the figures in the 46 fatalities, I find of the seven accidents in the period January to March, four occurred before lighting-up time, *i.e.* from one hour after sunrise till one hour after sunset, and three after lighting-up time, *i.e.* one hour after sunset to one hour after sunrise. Of the ten accidents in the period April to June, nine occurred before lighting-up time and one after; of the nine in the period July to September five before lighting-up time and four after; while of the 12 in the period October to December, four occurred before lighting-up time and 17 after. Moreover, the evidence in those cases where darkness prevailed at the time of the accident strongly pointed in the last 17 fatalities recorded (with the exception of some three doubtful cases) to such want of light being a prominent factor in the cause of death. Four of the "dark" accidents which occurred in November and December were caused by motor omnibuses on London Bridge at a time when the lights on the bridge and vehicles were mostly extinguished or obscured in accordance with the police regulations."

Street Accidents.

The following table (Appendix F) gives the number of street traffic fatalities which have occurred in the Metropolitan Police area and the City of London in each month of 1913 and 1914 respectively. This emphasizes the increase in deaths during October, November and December, 1914, the three months of enforced darkness of the streets.

Traffic fatalities in the Metropolitan area and the City of London in each month of the years 1913 *and* 1914.

	1913.	1914.
January	43	30
February	39	40
March	55	47
	—137	—117
April	43	33
May	67	43
June	53	50
	—163	—126
July	66	54
August	47	54
September	54	71
	—167	—179
October	47	92
November	55	55
December	56	89
	—158	—236

(Orders under the Defence of the Realm Regulations for the reduction of lighting were made on the 1st October, 31st October, and the 9th December, 1914.)

The Report continues :—

"It will be seen that the number of deaths during these three months exceeds by 78 the number for the corresponding months in 1913, and also exceeds the total of deaths in any of the three-monthly periods during the years 1913 and 1914.

"The biggest total next to that for the period October to December, 1914, is that for July to September, 1914, which total numbers 179 fatalities. This high figure may, I think, be accounted for largely by the increased consumption of intoxicating liquors indulged in, more especially by those run over and killed at the commencement of the war prior to the 'dark' period.

"In no one of the 46 cases has there been any evidence or suggestion that the driver of the vehicle has been drunk, or even under the influence of drink, at the time when he ran over and killed the deceased person. On the other hand the impression left on my mind is that some of the pedestrians killed, particularly in the earlier months following the outbreak of war,

were at the time of the accident under the influence of drink, and that the condition thereby induced contributed in a measure to the fatality."

The following information is given in an Appendix relating to the Home Office return for the street accidents in the Metropolitan Police District :—

"A Home Office return just issued shows that 637 fatal accidents were caused in the Metropolitan Police District in the year ending December, 1914, by vehicles in streets or public places. Of these 126 were caused by horse-drawn vehicles, 493 by mechanically-propelled vehicles, and 18 by pedal cycles. The non-fatal accidents numbered 25,239, of which 14,638 were caused by mechanically-propelled vehicles, 5,578 by pedal cycles and 5,023 by horse-drawn vehicles.

"Motor-omnibuses were responsible for 148 deaths, mechanically-propelled tramcars for 37, and other mechanically-propelled vehicles for 308. Of the non-fatal accidents 3,007 were caused by motor-omnibuses, 3,171 by mechanically-propelled tramcars, and 8,460 by other mechanically-propelled vehicles.

"There is nothing in the return to show what has been the effect on the number of street accidents of the darkening of London thoroughfares during the later three months of the year dealt with. A comparison with the previous year's return, however, shows that there has been a considerable increase in the number of accidents, those of a fatal character having grown from 579 in 1913 to 637 in 1914, and those who did not prove fatal from 18,944 to 25,239.

"In the City of London, which is separately dealt with, there were last year 19 fatal street accidents as compared with 17 in 1913, and 1,253 non-fatal as compared with 1,210 in 1913. The comparative fewness of traffic accidents in the City is, I think, attributable to the excellence of the police working directly under your Corporation, to the thorough and prompt manner in which means are taken for preventing accidents, and to the superior legal powers in connection with street traffic possessed by the City as compared with the Metropolitan Police District."

LIGHTS FOR VEHICLES.

The question of the light for vehicles also comes in for consideration :—

"As regards the important question of the need of lights on all vehicles, both behind as well as in front, and the display of such lights at an earlier hour than is the rule at present, especially during the autumn and winter months between September and March, and on foggy and dark evenings, and more especially during the darkened conditions of the streets, certain riders have been added by juries to their verdicts on traffic fatalities, and forwarded to the authorities. In one such case, a woman crossing a street in Islington, was killed by being run over, on the 23rd of October last, by a box tricycle without any light on it, at a time when the street was quite dark, notwithstanding the fact that the accident occurred 20 minutes before lighting-up time. The suggestion made and conveyed to the Home Secretary was that the lighting-up time should be altered, and that all vehicles should show a red light from sunset to sunrise in place of the present rule—from one hour after sunset to one hour before sunrise.

"In another instance the need of the new Home Office Order now partly in force, to the effect that all vehicles, including cycles and handcarts, shall show a red light, in addition to any other light, is clearly indicated, among others, by the following case. The inquest was held on the body of a man who, while pushing a hand-barrow without any light on it along Bishopsgate, at a time when the street was almost in darkness, was run into and killed by a motor omnibus. The driver of the omnibus in his evidence said he was unable, owing to the darkness of the street, to see the deceased man when he ran over him. In a recent case, when a woman was run over and killed by a motor-omnibus without lights in the Walworth Road, S.E., in the daytime during a thick fog, the jury suggested the compulsory use of lights on vehicles at such times. At present the only vehicle obliged to show lights during a fog is the tramcar."

In view of the limitation of the power of headlights during the War these cases are of special interest at the present moment.

SAFETY PRECAUTIONS IN VIEW OF THE DIMINISHED PUBLIC LIGHTING.

Shortly after the darkening of the streets the authorities found it necessary to issue a special warning against fast driving. It was pointed out that statistics showed a disquieting increase in the number of fatal accidents, and that, owing to the darkening of lights, much greater circumspection should be exercised by drivers and pedestrians.

Later the practice of whitewashing kerbs during the period of diminished illumination was recommended with a view to making the demarcation between pavement and roadway clearer. All this involves a clear recognition of the need for a certain measure of illumination in

the interests of traffic. It furnishes a precedent for the future determination of this desirable illumination on a scientific basis, which lighting engineers have advocated for some time past.

Another result of the diminished lighting has been to induce authorities to place a limit to the brilliancy of motor headlights—also a matter which has been discussed in this Journal on several occasions previous to the war.

One point of great importance is the question of the extinction of street lights in the event of a raid by hostile aircraft. Public opinion required guidance in this matter, and we are glad to observe that an official communication has been issued to local authorities intimating that the total extinction of lights in London would be most undesirable. It is pointed out that such a course would be fraught with most serious consequences, and would possibly bring about many more casualties than would be caused by the enemy aircraft; that in the event of fires breaking out the fire brigade would not be able to reach their destinations; that the traffic actually in the streets would be dangerously impeded, and that ambulance and police movements would be hindered; and that all the elements of panic would be introduced.

The circular also states that, as a result of numerous observations made from time to time, the Admiralty are satisfied that the present system of reduced lighting is the more satisfactory condition, since an observer from the sky is quite unable to determine the quarter of London he is passing over. According to expert opinion the extinction of street lighting would rather aggravate than reduce the danger to which the public are exposed.

The public would also do well to bear in mind the advice that gas should not be turned off at the meter at night, as this practice involves a risk of subsequent fire or explosion from burners left on when the meter was shut off—a risk which would out-weigh any advantage that might accrue from the gas being turned off at the time of a raid. These recommendations are in entire agreement with the suggestions recently made in an editorial in THE ILLUMINATING ENGINEER (February, 1915, p. 44).

VISIBILITY PROBLEMS IN WAR.

In a lecture before the Optical Society of London Mr. J. S. Dow, on May 13th, discussed some problems in visibility arising in war. The first portion of the lecture was devoted to a summary of recent progress in the design of searchlights and signalling apparatus, in the course of which frequent reference was made to the recent meeting of the Illuminating Engineering Society devoted to this subject. The second part of the lecture dealt mainly with the effects of light on the eye, and the conditions which rendered distant objects conspicuous or the reverse.

Mr. Dow emphasised the desirability of clear conceptions of the range and candlepower of searchlights, which he suggested might, with due care, be readily tested by the aid of modern photometric apparatus and even specified. Vision, the lecturer pointed out, played a great part in modern warfare, where the combatants fought a great deal at long range. There was constant competition between the combatants, the one trying to make his arrangements inconspicuous, the other trying to devise methods by which they could more easily be seen at a distance. As an instance the lecturer mentioned some optical devices which had been suggested for the purpose respectively of making periscopes of submarines indistinguishable to the enemy, and of detecting their presence. Reference was also made to various devices, such as protective colouring or painting objects with irregular patches which masked their outlines. It was pointed out that nearly all physiological factors tended to render distant red objects easily discernible, while blue objects, on the other hand, readily faded into the background. For this and other reasons red light might be favoured for signalling purposes.

In the discussion Mr. Justus Eck mentioned the change in the design of soldier's caps for trench work, as an instance of the attempt to avoid sharp outlines; the flat top, he understood, caught the eye more easily than an irregular soft cap would do. Mr. Eck also mentioned some additional applications for searchlights, for example, as an adjunct to fire-engines. He also

described an ingenious refinement which was now fitted to the Beck searchlight, namely, the use of small selenium cell to control the position of the arc automatically and keep it always at the focus of the projector. Dr. Ettles, who was in the Chair, explained how the appearance of distant blue objects was affected by the chromatic aberration of the eye. Mr. Bryan mentioned an interesting instance of the use of blue light for illuminating the interior of guns, the idea being to secure an illumination which could not easily be seen at a distance. The significance of the "candle-power" of the searchlight, and its relation to the intrinsic brightness and superficial area of the illuminant were also discussed at some length.

THE EEFECT OF ULTRA-VIOLET LIGHT ON THE EYE.

The study of the effects of ultra violet and infra-red radiation on the eye is attended with many difficulties, and past researches on these points have led to somewhat conflicting results.

Many of these experiments relate to the formation of "cataract," *i.e.*, a disease of the eye in which the crystalline lens becomes opaque and forms an apparent grating over the pupil. There are several facts to be accounted for, among them being (1) the tendency to cataract in old age, (2) the prevalence of this disease among workers in certain trades, notably among glass workers, (3) the prevalence of the disease in the tropics, (4) the tendency to cataract among people subject to certain diseases, such as diabetes.

On examination of these four points it would appear from (1) and (4) that cataract may have a physiological cause, such as some form of malnutrition. On the other hand (2) and (3) suggest that exposure to exceptionally strong light, glowing furnaces, etc., is a factor of consequence. The probability is that both causes are opperative.

Some striking experiments which confirm this view were recently carried out in the United States by W. E. Burge.*

In order to test the effect of the visible spectrum, and of the infra-red and ultra violet rays the author exposed various solutions containing egg-white, blood-serum, aqueous and vitreous humour, and also excised pig and ox lens, to these forms of radiation. For some of these experiments an electric furnace which is particularly rich in infra-red rays, was used. For testing the effects of strong visible light a gas-filled incandescent lamp of 2,000 c.p. was focussed on the lens and solutions, exposure being made for as much as 100 hours. For the production of ultra violet rays a quartz tube mercury vapour lamp giving about 2,500 c.p. was employed.

The general result of these experiments was as follows. No appreciable coagulation, either in the solutions or the lenses, could be traced to the visible or infra-red rays. It is true that coagulation could be produced by very strong concentration of these forms and energy, but the result was shown to be due to a great rise in temperature (such as could never be approached under ordinary conditions) and not to the intrinsic effect of the radiant energy itself. When arrangements were made to prevent this rise in temperature, coagulation did not occur.

In the case of the ultra violet rays an exposure for 20 hours to the quartz tube at a distance of 5 centimetres, coagulated the solutions in the course of 20 hours. But even after 100 hours' exposure the lenses of the aqueous humour were practically unaffected, and the vitreous humour was only rendered very slightly clouded. The author considers it remarkable that, although ultra violet radiation coagulates egg-white solution, and practically every other protein and related substance, the aqueous and vitreous humours and the lenses resisted their influence. This suggests that there is some special quality in the protein substances in the eye which enable it to resist the effect of ultra violet rays. Some light is thrown on this point by the author's analysis of several thousand cataractous eyes received from the United States and India; in these cases a great increase above the normal in the amount of certain salts was found to exist. For example, while the percentage of potassium is reduced, the percentage of calcium,

* *Elect. World*, April 10th, 1915.

magnesium and sodium are greatly increased above the amounts existing in the normal lenses. In the cases of the eyes received from India, silicates were present. It seems, therefore, that the presence of these substances in the eye may diminish the power of resistance to coagulation. In order to test this point the author immersed the specimen eyes in solutions of calcium and magnesium chloride, sodium silicate, and dextrose.

In these circumstances also no appreciable coagulation could be produced by infra-red and visible rays (provided as before that the effect of rise of temperature was excluded), but on exposure to ultra violet light, the portion of the lens on the side facing the burner, became an opaque mass in 25 minutes. This occured in the case of the lens immersed in calcium chloride, but a similar but less marked effect was met with in the presence of the other solutions.

The conclusion would appear to be that two distinct factors should be considered: (1) a modification of the protein of the lens due to malnutrition or disease, and (2) long exposure to powerful ultra violet radiation, such as exists in the sunlight of the tropics. The above experiments also explains why sufferers from diabetes are particularly subject to cataract, since it is known that this disease gives rise to an accumulation of dextrose in the system.

A NEW TYPE OF ELECTRODES FOR AN IMPROVED ARC LAMP.

In the United States, as is well known, magnetite arc lamps have been very widely used for street lighting. In an article in the *Electrical Review and Western Electrician*,* Mr. Isador Ladoff mentions the use of a new type of electrode termed "ferro-ilmenite" which is stated to give an efficiency of near 4 mean spherical candlepower per watt. This is claimed to be the highest efficiency yet reached with an electrical illuminant. The efficiency of an ideal monochromatic illuminant, yielding only light of wave length 0·545μ is given as 63·6 sph. c.p. per watt. Taking this value as 100 the percentage of light from the energy given to the ferro-ilmenite arc is only about 6 per cent., so that we have still much to do before the ideal conditions are approached. It should, however, be recognised that a certain loss in efficiency is inevitable if we desire to have correct colour-revealing qualities, *i.e.*, an approximate "white light." The efficiency of an ideal "white light" would not be more than 24 sph. c.p. per watt.

In the case of arcs using metallic electrodes the constitution of the cathode is the important point which settles the quality of the light. Ferro-ilmenite cathodes appear to be composed of a mixture of titanium oxide, chromium oxide, and sodium uranate. Hitherto, copper anodes have been used with this type of arc, but the author finds that anodes of graphite or iron are preferable. Still better results are obtained if anodes of this material are protected with tips of copper.

* April 10th, 1915, p. 691.

GAS LIGHTING AT THE PANAMA-PACIFIC EXHIBITION.

The *Journal of Gas Lighting* for July 6th contains several interesting photographs showing the use of high-pressure gas lamps at the Panama-Pacific Exhibition. One of these photographs shows the Netherlands Buildings on either side of which are spaced high-pressure lamps each yielding 1,160 (mean hemispherical) candles. The other photograph refers to the west end of the Palace of Fine Arts. Here the "flood-lighting" of the building and statuary is the most striking feature. High-pressure gas lighting is used throughout in this quarter and is widely employed for the colonades and boulevards in the Foreign Section.

Gas also plays an important part in the form of flambeaux for producing special ornamental effects, and in many quarters low-pressure lighting is installed for emergency purposes.

ILLUMINATION OF THE PANAMA-PACIFIC INTERNATIONAL EXHIBITION.*

By W. D'A. Ryan.

Everyone in this country has been so engrossed in the war that the opening of the great Panama-Pacific Exhibition received comparatively little attention. It was anticipated that the lighting would be of a highly novel character, and in The Illuminating Engineer for October, 1914, an account was given of the projected arrangements. Mr. W. D'A. Ryan, under whose supervision the whole scheme was carried out, has now contributed an illustrated article on the subject in a recent issue of the *General Electric Review*, which is too interesting to be overlooked. To those in dimly-lighted London whose minds are oppressed by the war, it seems curious to read of the gorgeous spectacular lighting effects in San Francisco; but in the distant future, when we are free once more to study illumination effects of this kind, the novel methods used for the lighting of this exhibition should not be forgotten.

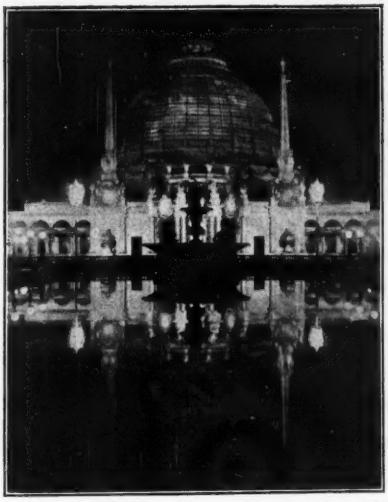


Fig. 1.—Palace of Horticulture.

Fig. 2.—Tower of Jewels.

Note reflections in the water of the West Lagoon of the South Garden.

It appears from this account great ingenuity has been shown. The chief respect in which the lighting differs from that in most exhibitions of the past is the absence of glare. Methods of concealed lighting have taken the place of festoons of naked incandescent lamps and an attempt has been made throughout to combine the resources of the lighting engineer and the art of the architect. The results obtained by Mr. Ryan and his staff of engineering assistants are largely due to the fact that from the very inception, they worked in co-operation with the architectural commission engaged in planning the Exhibition. "For the first time in history the lighting of an International Exhibition was completely designed and chartered before the building was erected."

In what follows we summarise Mr. Ryan's account of the lighting arrangements :—

The illumination of the Exposition marks an epoch in the science of lighting and the art of illumination. Like many

* Abstract of an article in *The General Electric Review*, June, 1915.

other features of the Exposition, the illumination is highly educational in character and emphasizes more than anything that has gone before the result of concentrated study in the best uses and application of artificial light.

Previous exposition buildings have, in the main, been used as a background on which to display lamps. The art of outlining, notably the effects obtained at the Pan-American Exposition at Buffalo, could probably not be surpassed. This method of illumination has, however, been extended to amusement parks throughout the world and is now commonplace. Its particular disadvantage is that it suppresses the architecture which becomes secondary and it is practically impossible to obtain a variety of effects, so that the Exposition from every point of view presents more or less similarity. Furthermore, the glare from so many exposed sources particularly when assembled on light coloured buildings causes eye strain. Prior to the opening night of the Exposition, there were many who maintained that the public would not be attracted except by the glare of exposed sources and great brilliancy, which was analogous to saying that the masses could be attracted only by one form of lighting. The results obtained, however, clearly disproved this theory.

The lighting effects are radical, daring and in every sense new, the fundamental features of which consist primarily of masked lighting diffused upon softly illuminated facades emphasised by strongly illuminated towers, and minarets in beautiful colour tones.

The direct source is completely screened in the main vistas and the " behind the scenes " effects are minimized to a few locations and are nowhere offensive.

Furnishing wonderful contrast to the soft illumination of the palaces, with their high lights and shadows, we have the zone, or amusement section with all the glare of the bizarre, giving the visitor an opportunity to contrast the light of the present with the illumination of the future. As we pass from the Zone with its blaze of lights, we enter a pleasing field of enticement or carnival spirit. We are first impressed with the beautiful colours of the heraldic shields on which is written the early history of the Pacific Ocean and California. Behind these banners are luminous arc lamps in clusters of two, three, five, seven and nine, ranging in height from 25 to 55 feet. We look from the semi-shadow upon beautiful vistas and the Guerin colours which fascinate in the daytime are even more entrancing by night. The lawns and shrubbery surrounding the buildings and the trees with their wonderful shadows appear in magnificent relief against the soft background of the palaces and the " Tower of Jewels " with its 102,000 " Nova-gems," or so-called exposition jewels, standing mysteriously against the starry blue-black canopy of the night, surpassing the dreams of Aladdin.

As we enter the " Court of Abundance " from the east, with its masked shell standards strongly illuminating the cornice lines and gradually fading to twilight in the foreground, we are impressed with the feeling of mystery analogous to the prime conception of the architect's wonderful creation. Soft radiant energy is everywhere; lights and shadows abound, fire spits from the mouths of serpents into the flaming gas cauldrons and sends its flickering rays over the composite Spanish-Gothic-Oriental grandeur. Mysterious vapours rise from steam-electric cauldrons and also from the beautiful central fountain group symbolizing the Earth in formation. The cloister lanterns and the snow-crystal standards give a warm amber glow to the whole court and the organ tower is carried in the same tone by coloured searchlight rays.

Passing through the " Venetian Court," we enter the " Court of the Universe," where the illumination reaches a climax in dignity, thoroughly in keeping with the grandeur of the court, where an area of nearly half a million square feet is illuminated by two fountains, rising 95 feet above the level of the sunken gardens, one symbolising the rising sun and the other the setting sun.

The shaft and ball surmounting each fountain is glazed in heavy opal glass which is coated on the outside in imitation of travertine stone so that by day they do not in any sense suggest the idea of being light sources. Mazda lamps installed in these two columns give a combined initial mean spherical candle-power of approximately 500,000 and yet the intrinsic brilliancy is so low that the fountains are free from disagreeable glare and the great colonnades are bathed in a soft radiance. For relief lighting three Mazda lamps are placed in specially designed cup reflectors located in the central flute to the rear of each column. This brings out the Pompeian red walls and the cerulean blue ceilings with their golden stars and at the same time the sources are so thoroughly concealed that their location cannot be detected from any point in the court.

The perimeter of the " Sunken Garden " is marked by balustrade standards of

unique design consisting of Atlantes supporting urns in which are placed Mazda lamps of relatively low candle-power. The function of these lights is purely decorative.

The great arches are carried by concealed lamps, red on one side and pale yellow on the other, thereby preserving the curvature and the relief of the surface decorations. The balustrade of this court, 70 feet above the sunken garden, is surmounted by 90 seraphic figures with jeweled heads. These are cross lighted by 180 Mazda searchlights, the demarcation of the beams being blended out by the light from the Palace of Fine Arts bathed in triple moonlight and casting reflections in the lagoon impossible to describe. The effect is produced by searchlights on the roofs of the Palaces of Food Products and Education supplemented by concealed lighting in the rear cornice soffits of the colonnade.

You have only passed through the central, east and west axis of the Exposition. There are many more marvels to be seen. If you wish to study the art of illumination you could visit the Exposition every evening throughout the year and still find detail studies of interest. For instance, did you ever see artificial

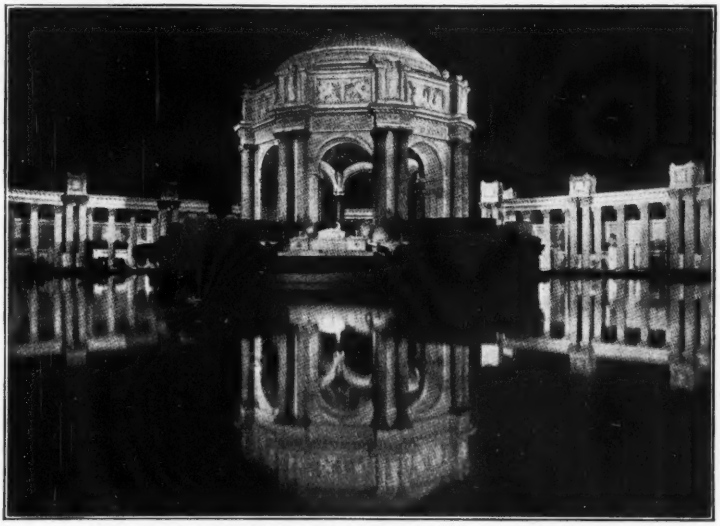


FIG. 3.—Rotunda and Colonnade of the Palace of Fine Arts.

fountains of the rising and the setting sun.

Passing through the Venetian Court to the west, we enter the "Court of the Four Seasons," classically grand. We are now in a field of illumination in perfect harmony with the surroundings, suggesting peace and quiet. The high current luminous arcs mounted in pairs on 25 ft. standards masked by Greek banners are wonderfully pleasing in this setting. The white light on the columns causes them to stand out in semi-silhouette against the warmly illuminated niches with their cascades of falling water, and the placid central pool reflects in marvellous beauty scenes of enchantment.

Having reviewed in order illuminations mysterious, grand and peaceful, we emerge from the West Court upon lighting classical and sublime, the magnificent illumination in competition with daylight? On certain occasions the projectors flood-light the towers before the sun goes down. If you are fortunate enough to be present, take up a position in the northwest section of the "Court of the Universe" and watch the marvellous effect of the "Tower of Jewels" as the daylight vanishes and the artificial illumination rises above the deepening shadows of the night. The prismatic colours of the jewels intensify and the tower itself becomes a vision of beauty never to be forgotten.

The South Garden may very properly be called the fairy-land of the Exposition at night. When the lights are first turned on, the five great towers are bathed in ruby tones and they appear with the iridescence of red hot metal.

This gradually fades to delicate rose as the flood-light from the arc projectors converts the exterior of the towers into soft Italian marble. The combination of the projected arc light (white) and the concealed Mazda light (ruby) produces shadows of a wonderful quality. Each flag along the parapet walls has its individual projector which converts it into a veritable sheet of flame.

As a primary line of colour the heraldic shields and cartouche lamp standards produce a wonderful effect against the travertine walls bathed in soft radiance from the luminous arcs which also bring out the colour of the flowers and lawns and create pleasing shadows in the palms and other tropical foliage. This is supported by a secondary effect in the decorative Mazda standards along the "Avenue of Palms" and throughout the garden. A finishing touch is added by the effect of life within created by the warm orange light emanating from all the Exposition windows supported by red light in the towers, minarets and pylon lanterns.

To the west we have the enormous glass dome of the Palace of Horticulture converted into an astronomical sphere with its revolving spots, rings and comets appearing and disappearing above and below the horizon and changing colours as they swing through their orbits. The action is not mechanical, but astronomical.

To the east, we have the "Festival Hall" flood-lighted by luminous arcs and accentuated by orange and rose lights from the corner pavilions, windows, and lantern surmounting the dome, all reflected in the adjacent lagoon and possessing a distinctive charm which will long remain in the memory.

Purely spectacular effects have been confined to the scintillator at the entrance of the yacht harbour. This consists of 48 36 in. projectors having a combined projected candle-power of over 2,600,000,000. This battery is manned by a detachment of United States Marines.

A modern express locomotive with 81 in. drivers is used to furnish steam for the various fireless fireworks effects known as "Fairy Feathers," "Sun-Burst," "Chromatic Wheels," "Plumes of Paradise," "Devil's Fan," &c. The locomotive is arranged so that the wheels can be driven at a speed of 50 or 60 miles per hour under brake, thereby producing great volumes of steam and smoke, which, when illuminated with various colours, produces a wonderful spectacle.

The aurora borealis created by the searchlights reaches from the Golden Gate to Sausalito and extends for miles in every direction. The production of "Scotch Plaids" in the sky and the "Birth of Colour," the weird "Ghost Dance" "Fighting Serpents," the "Spook's Parade" and many other effects are fascinating.

Additional features consist of ground mines, salvos of shells producing "Flags of All Nations," grotesque figures and artificial clouds for the purpose of creating midnight sunsets.

Over 300 scintillator effects have been worked out and this feature of the illumination is subject to wide variation. Atmospheric conditions have a great influence upon the general lighting effects; for instance, on still nights the reflections in the lagoons reach a climax, particularly the Palace of Fine Arts as viewed from Administration Avenue; the facades of the Education and Food Products Palaces as seen in the waters through the colonnade of the Palace of Fine Arts; the Palaces of Horticulture and Festival Hall from their respective lagoons in the South Garden; the colonnades and the Nova-gems on the heads of the seraphic figures, and the "Tower of Jewels" as reflected in the water mirror located in the North Arm of the "Court of the Universe."

On windy nights the flags and jewels are at their best. On foggy nights wonderful beam effects are produced over the Exposition impossible at other times. When the wind is blowing over the land the scintillator display is different from nights when the wind is blowing across the Bay. A further variety is introduced in the action of the smoke and steam on calm nights.

On the evening of St. Patrick's Day all the searchlights were screened with green; not only the towers but every flag in the Exposition took on a new aspect.

Orange in various shades was the prevailing colour for the evening of Orange Day and on the ninth anniversary of the burning of San Francisco the Exposition was bathed in red, with a strikingly realistic demonstration of the burning of the "Tower of Jewels."

High pressure gas lighting plays an important part in street lighting in the foreign and state sections; low pressure gas for emergency purposes, and gas flambeaux for special effects.

The accompanying illustrations suggest some idea of the illumination, but the addition of colour is absolutely necessary to convey anything approaching a correct impression of the night pictures of the Exposition.

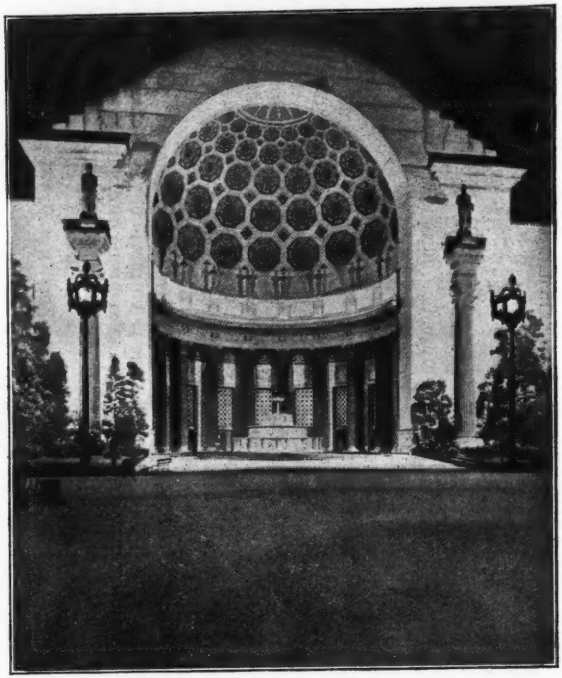


FIG. 4.—West entrance to Food Products Palace, showing 35 ft. 3-light luminous arc cartouche standards.

FIG. 5.—Entrance to Varied Industries Building, lighted by 3-light luminous arc cartouche standards.

SOME NOTES ON THE USE OF LIGHT IN CINEMATOGRAPH WORK.

By AN ENGINEERING CORRESPONDENT.

There are many interesting applications of light in connection with cinematograph work, which deserve the attention of the illuminating engineer. Broadly, there are three distinct sections of the subject to be investigated: (a) The lighting of the picture palaces in which the film is displayed; (b) the design of the projecting apparatus and the study of the illuminants used therewith; (c) the lighting arrangements used in the studio where the photographs are taken.

LIGHTING OF THEATRES.

Some notes on the lighting of picture palaces appeared in THE ILLUMINATING ENGINEER about two years ago.* In the higher class of cinematograph theatres the lighting is now carried out with considerable skill, and is usually well adapted to the purpose in view. There are, however, still some points to be investigated, and, from a decorative standpoint, there are great possibilities. The fundamental point in such lighting is that all unduly bright lights liable to cause glare must be rigorously avoided. As a rule the audience sit in almost complete darkness; in these circumstances even an unscreened candle flame used by the performer at the piano has been found inconvenient. One reason for this is that in a weak illumination the peripheral region of the retina is highly sensitive to light; consequently glare from bright objects seen out of the "tail of the eye" is accentuated. From the standpoint of safety it is generally agreed that a small amount of subdued light is desirable in the auditorium, and there are reasons for thinking that this is also advantageous with a view to comfort of vision. An excessive contrast between the brightly illuminated screen and the relatively dark surroundings in the auditorium is, in some measure, inconvenient to the eye. It is recognised that the abrupt "shock" produced by suddenly turning off all the lights in the auditorium is trying to the eyes, and the use of "dimmers" is now recommended in order that the illumination may gradually be diminished. But it is also possible that a permanent very strong contrast between the picture and the surroundings may be productive of strain, and that the audience would see more conveniently if the ratio between the brightness of the screen and the brightness of the surroundings was kept within a certain limit. This limit remains to be determined. Experience suggests that the illumination in the auditorium should be of the order of 0·2 to 0·5 foot-candles; at a rough guess one would estimate that in these circumstances the brightness of the surroundings on a level with the audience would be about one-twentieth to one-fiftieth of that of the screen; but if this illumination were produced by concentrating reflectors the brightness of the upper part of the auditorium would be considerably darker, so that the average value of the ratio might be greater than the figure quoted. In his well-known recommendations for the avoidance of glare Prof. L. Weber suggested that a contrast of more than 100 : 1 gave rise to glare, and this seems in fair agreement with the conclusions so far reached in the lighting of rifle ranges.

Indirect and semi-indirect methods of lighting seem particularly well adapted to the lighting of auditoriums; clusters of lamps mounted on the ceiling are also useful for the purpose of producing the desired general illumination. Chandeliers situated anywhere near the direct range of vision should not be used.

ILLUMINANTS AND PROJECTOR APPARATUS.

The illuminants suitable for projector work are, generally speaking, those which are also available for searchlights.* Intrinsic brilliancy is the most important factor. Where electricity is available the

* Vol. 6, 1913, p. 476.

* See *Illum. Eng.*, Feb. 1915.

arc light, the intrinsic brilliancy of which (estimated at 120—140 c.p. per sq. millimeter) considerably exceeds that of other sources, is naturally preferred. In other cases limelight and the oxy-acetylene incandescent system are used. For small model projectors incandescent tungsten lamps have possibilities, and future developments in this field may lead to their being more widely employed. Half-watt lamps have been designed for projector work, and the latest bunched spiralised filaments represent a great advance on the lamps of a few years ago. We shall probably see a further improvement both in the intrinsic brilliancy of the filament and in its construction. From the optical standpoint a filament, however ingeniously arranged, is naturally inferior to an approximately spherical and continuous incandescent area such as exists in the electric arc or limelight. On the other hand the heat developed is much less, and this may enable the source to be brought nearer the condensing lens. The fact that small units are readily available is a convenience for work in small rooms. One drawback there would seem to be—the danger of an incandescent lamp filament unexpectedly giving way during a performance. If, however, a well-designed arrangement were embodied for immediately switching into circuit a spare lamp kept ready for the purpose, the interruption might escape notice.

No information is available as to the application of cooled electrodes in projectors on the principle used in the Beck searchlight. The added complexity of the system would be a drawback, and the first cost inevitably much greater. But the fact of being able to obtain four times the light for the same current, as is reputed, might mean that the initial cost would be more than compensated by the saving in running expenses.

When it is recalled that projectors used for cinematograph work frequently consume 50 ampères at 65 volts, it will be understood that the cost of electricity may be a considerable item. When only a high electric pressure, say 200 or 250 volts, is available, it is wasteful to lose all the excess P.D. on a resistance, and a motor-generator converting the pressure to 65—70 volts is well worth the first cost of installation, which will be covered by the saving in running cost during the first few months.

It is also well known that an alternating current is much less satisfactory than direct current for projector work, owing to the fact that the tips of both carbons shape alike and no well-defined incandescent crater is formed. Moreover, greater skill is usually required in order to get a steady light from an alternating arc. As a rule, therefore, it is better to install an auto-converter and transform from alternating to direct current.

The design of the optical system of the projector hardly falls within the scope of this journal, except in so far as it affects the efficiency of the projector. The system consists essentially of two parts, (a) the condensing lens and (b) the projecting or image-forming lenses. Limitations in lens manufacture, and the necessity of avoiding any danger of the condenser being cracked by the heat, both restrict the luminous efficiency of the system. Few people realise how small is the percentage of the light produced in the arc which is actually usefully employed on the screen. The brightness of the latter is much less than is generally supposed. In a number of theatres recently tested by the author it did not exceed 1—2 foot-candles. Now, in the case of a screen ten feet square, the flux of light received by it in these circumstances would be 100—200 lumens. Therefore, if *all* the light produced in the arc were usefully employed only $\frac{100}{4\pi}$—$\frac{200}{4\pi}$, *i.e.*, approx. 8—16 spherical candle-power, would be needed! In practice several thousand candle-power might be required to produce this illumination, so that the "useful efficiency" of the projector could be set down as less than 1%.

This example serves to illustrate the great theoretical scope for improvement in the design of the optical system, but it seems difficult to secure any substantial improvement without departing entirely from the principles which have been tried and tested for so many years.

But this by no means exhausts the elements of inefficiency. Even when the picture has been formed on the screen a

great deal of light is scattered from its illuminated surface in useless directions. In general, a cinematograph theatre is long and narrow so that a maximum number of people can be present looking directly towards the screen. The rays of light that are scattered in oblique directions, where there are no spectators, is therefore wasted. Attempts have been made to improve the efficiency of the screen by using screens of powdered aluminium which reflect a much larger percentage of the light towards the audience and yet diffuse the light sufficiently to produce a continuous image. Such screens have been scientifically grooved and rippled to bring the light back to the audience, and it is said that in this way an image bright enough to be seen in broad daylight can be obtained. Yet there are various practical difficulties, and such screens have not been widely adopted in this country.

There remains to be mentioned yet another possible line of research, in which a number of experiments are being made —the production of a stereoscopic image. If to the excellent definition now attainable in the cinematograph image one could add the effect of depth and distance, a great step forward would have been taken; but this, too, is still in the experimental stage.

The Lighting and Equipment of Studios.

In the third section of cinematograph work, taking photographs of subjects for exhibitions, artificial light plays a great part. It would probably be agreed that good daylight conditions are the most satisfactory of all for this purpose; on the other hand, daylight is a very variable quantity, particularly in northern latitudes. Considerable fluctuations in illumination during the taking of a film would naturally inconvenience the producer. If these variations are undetected by the eye, the film may be under- or over-exposed. It is well known that considerable changes in the strength of daylight are apt to escape notice owing to the eye's great power of adaptation to varied conditions. It seems reasonable to suppose, therefore, that photometry might be a useful check. If the illumination were observed through an instrument of the lumeter class while the film is in progress, warning could be given at any moment if the light were diminished or increased by more than a certain amount. The advantage of artificial light lies in the fact that it is more under control than daylight, and more constant in strength. An artificially lighted studio can be used irrespective of the climatic conditions in summer and winter, and films can be prepared even though the light out of doors may be insufficient for photography.

There appear to be, generally speaking, two distinct classes of studios, those (usually fairly large in area) lighted on a permanent scheme with the sources of light in fixed positions, and those (in which smaller scenes are staged) lighted by portable units. In some cases the overhead units are arranged on a travelling rack so that they can be transferred bodily to a series of studios under the same roof. An article in our last issue gave some information on this point, dealing, however, mainly with the use of mercury vapour lamps.*

In any case the arrangements of the light and shade require considerable care. If the brightness of the sources is too concentrated, harsh shadows would be produced, the contrasts would be excessive, and some detail in the film would be missing. On the other hand, if the light is too completely diffused, there will be a lack of shadow and the film will be "flat." It is necessary to strike a mean between these conditions, and, as a rule, the lighting consists of a combination of general diffused illumination supplemented by light coming from some special direction. The shadow conditions which are aimed at will naturally depend on the nature of the scene. For example, they will vary according as the scene is supposed to take place in a room lighted artificially by chandeliers, candles, etc., or in full open daylight. In addition, a special arrangements will be made for firelight scenes, etc. The time of exposure for each picture in a cinematographic film is of the order of one-sixty-fourth of a second, and it will, therefore, be understood that a very high illumination is necessary. Curiously enough, no data

* *Illum. Eng.*, June, 1915, p. 284.

seem to have yet been published regarding the illumination provided; but if arc lamps or mercury vapour lamps are used, one may assume that it is of the same order as would be required by daylight and would amount to hundreds of foot-candles. This figure, however, naturally depends to some extent on the actinic qualities of the light used. As was mentioned in the article in our last issue (*loc. cit.*) mercury vapour lamps are widely used for the purpose, partly on account of the high actinic value of the light, and partly because of the soft and diffused character of the illumination produced by the long tubes. When arc lamps, or gas-filled incandescent lamps are used, a translucent screen is usually fixed in front of the source so as to soften the shadows. It is stated that the half-watt lamp is about one-third to one-fourth as actinic as daylight and the mercury vapour lamp. It is interesting to observe that of the four lines which are prominent in the visible spectrum of the mercury lamp the line 546 $\mu\mu$ is located at the point of maximum sensibility of the eye; while the line 404 $\mu\mu$ is lighted approximately by the point of maximum sensibility of the photographic plate.

A recent article by Mr. V. A. Clarke in the *Electrical World*,* compares the efficiency of various forms of arc lamps for cinematograph work. From the standpoint of minimum cost to secure a given photographic effect the 200-volt direct current enclosed arc taking 150 volts across the arc and consuming 3 amperes was found to be the most economical. The comparative efficiency of ordinary and flame arcs, both for direct and alternative current, depends to some extent on the special circumstances. The following data, taken from an interesting paper read by Mr. Luckiesh before the Illuminating Engineering Society in the United States,† give an idea as to the lighting requirements of various studios :—

I. Set about 16. ft. by 30 ft. (4.9. by 9.1 m.).
124 mercury-vapour tubes, d.c., 112 volts, 3.5 amperes.
Energy used, about 50 kw.
Lamps arranged in banks of 8 each.
Placed 48 overhead inclined at about 30 deg. from horizontal and 12 ft. (3.65 m.) from floor.
64 on one side in banks two tiers high.
12 at front 7 ft. (2.1 m.) above floor.
Actors worked to within 10 ft. (3 m.) from front lights.

II. Set about 16 ft. by 25 ft. (4.9 by 7.6 m.).
24 carbon arcs, a.c., 220 volts, 14 amperes.
Energy used, approximately 50 kw.
Placed 16 overhead and 8 in front about 8 ft. (2.4 m.) from floor.
Actors worked to within 10 ft. (3 m.) from front lights.

III. Set about 14 ft. by 20 ft. (4.3 by 6 m.).
18 carbon arcs, d.c., 110 volts, 20 amperes.
2 30-ampere carbon arcs in series for flood light through a window.
Energy used, approximately 43 kw.
Placed 12 in front and 6 on side near front from 4 to 7 ft. (1.2 to 2.1 m.) from floor.
Actors worked to within 5 ft. (1.5 m.) of front lights.

IV. Set about 15 ft. by 15 ft. (4.5 m.).
12 carbon arcs, d.c., 110 volts, 20 amperes.
Energy consumed, approximately 27 kw.
Placed in front overhead in two rows about 8 ft. and 9 ft. (2.4 and 2.7 m.) from floor.
Actors worked to within 7 ft. (2.1 m.) of front line of lamps.

V. Set about 12 ft. by 24 ft. (3.6 by 7.3 m.).
48 mercury arcs, d.c., 110 volts, 3.5 amperes.
2 carbon arcs, d.c., 110 volts, 28 amperes.
2 carbon arcs, d.c., 110 volts, 30 amperes.
3 quartz mercury arcs, d.c., 110 volts, 3.5 amperes.
The 3 quartz mercury arcs and 2 carbon arcs were in front and the 48 mercury arcs were distributed on one side with the exception of two banks of 8 each which were near the front on the other side. None overhead. The 2 30-ampere carbon arcs were on the side near the front and about 10 ft. (3 m.) from the floor. These gave a marked effect in the picture. This appeared to be an exceptionally intelligent attempt to obtain good lighting effects.
Energy consumed, about 33 kw.
Actors worked to within 7 ft. (2.1 m.) of front line of lamps.

VI. Set about 10. ft. by 10 ft. (3 m.).
11 1,000-watt gas-filled tungsten lamps, 110 volts.
Placed in front corners about 8 ft. (2.4 m.) from floor. More lamps on one side than the other.
Energy consumed, 11 kw.
Light well controlled by angle reflectors.
Actors worked to within 5 ft. (1.5 m.) of front line connecting the lamps.

VII. Set about 10 ft. by 15 ft. (3 by 4.5 m.).
16 1,000-watt special blue-bulb, gas-filled tungsten lamps, 110 volts.
Placed 8 in front, 6 on side near front, 2 overhead.

* Nov. 14, 1914, p. 956.

† *Trans. Ill. Eng. Soc.* (U.S.A.), Vol. X. No. 2, 1915, p. 181.

Energy consumed, 16 kw.
Actors worked to within 7 ft. (2.1 m.) of front.

There has been much speculation as to the utility of the recently introduced half-watt (gas-filled) incandescent lamp for cinematograph and portrait work. They appear to be of value for enlargement and printing purposes, but their presumably lower actinic value would make them less efficient for cinematograph work than arc lamps or mercury vapour lamps. According to Mr. Luckiesh the actinic value of such lamps for a given illumination is only one-third to one-fourth that of daylight or the mercury vapour lamp. Moreover, their intrinsic brilliancy makes it necessary for a translucent screen to be used.

But it is expected that such lamps will form a useful adjunct for accentuating the light in certain directions; for this purpose the small volume of the luminous area, which enables focussing reflectors of various types to be used and the light to be more completely controlled, is claimed as an actual advantage.

It is also suggested that even for cinematograph work as now conducted the approximately white character of the light used by these lamps it advantageous.

Although cinema pictures operate in black and white the distortion of colour caused by mercury vapour lamps alone may, in certain scenes, be undesirable. And if hopes are realised of ultimately producing applying colour photography to cinematograph work, the use of an illuminant giving an approximately white light would become essential. Mr. Luckiesh has also found the gas-filled lamp serviceable in connection with ordinary indoor portrait work, and has made one interesting modification. In order to secure a short exposure the light has to be very powerful and the glare from the lamp would be somewhat trying to the subject, even if screened in the usual way. Mr. Luckiesh has therefore introduced a glass screen which has the effect of diminishing the luminous value of the light to 30 per cent., but leaves its photographic value practically unaffected. The screen has also the quality of making the colour of the light an apparent match with daylight; it could, therefore, be used to supplement daylight if desirable. Finally, there is the advantage that the actinic power, corresponding with a given luminous effect, is the same as for daylight when this screen is used. In fact, it produces what may be called "approximate photographic daylight."

COMBINED CENTRAL AND BRACKET LIGHTING IN A DRAWING ROOM

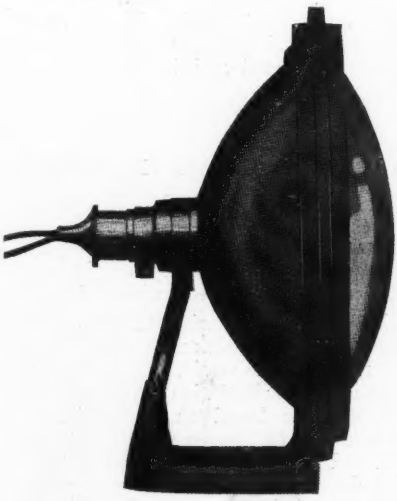
At one time there was much discussion regarding the comparative merits of central and bracket lighting in a small drawing room. When the indirect and semi-indirect lighting systems became common, the former method received a distinct stimulus.

Many people, however, consider that a combination consisting of a central semi-indirect unit, supplemented by well-shaded bracket lights, is the best arrangement. The illustration shows a good modern example of this method. The general effect is soft and the bracket lights just suffice to remove any impression of "flatness" which might otherwise exist.

SHORT NOTES ON ILLUMINATING ENGINEERING.

ILLUMINATION OF SIGNS AND BUILDING EXTERIORS BY PROJECTORS.

IN the *Electrical Review and Western Electrician*,* an account is given of a new form of "flood-light" type of lighting unit which is being used in the United States for illuminating the outsides of buildings, signs, and other objects.



This projector consists of a highly polished aluminium parabolic projector 16 in. in diameter and mounted in an iron frame. The front is covered with curved heat-resisting glass. A 500 watt focus type gas-filled lamp is mounted with the filament at the focus of the reflector. In this way approximately 400,000 apparent candle-power is obtained. By putting the lamp slightly out of focus a spread of 18° is obtained, the apparent candle-power in this case being 150,000.

By a slight adjustment the unit can therefore be employed to illuminate either very distant objects or those which are comparatively near at hand. With the projector located 100 feet away and the beam concentrated to 6° a minimum spread of about 10 feet, with an average foot-candle intensity of 30 foot-candles, is obtained. By increasing the dispersion to 18° the maximum spread is about 30 foot and the average intensity of illumination 5 foot-candles.

Some illustrations are given of buildings illuminated in this way. They appear very conspicuous against a dark background. For average conditions 2 foot-candles are usually sufficient. A special use of the projectors is for illuminating signs which cannot be conveniently lighted by lamps on the spot.

* May 29th, 1915.

ARTIFICIAL DIGESTION BY ULTRA-VIOLET RAYS.

ACCORDING to a report published in the daily Press, Professor Daniel Bertholet claims to have reproduced artificially the processes of digestion by the action of ultra-violet rays from a mercury vapour lamp on food substances contained in a quartz vessel.

The processes were produced without the aid of ferments, which play so great a part in the natural processes.

PHOTOMETRIC TESTS OF STREET LAMPS IN A LAWSUIT IN PHILADELPHIA.

ACCORDING to the *Electrical World* a lawsuit recently took place in Philadelphia with reference to the candle-power of about 18,000 gasolene mantle street lamps in outlying districts. The contract specification stated that lamps were to be tested photometrically as to the actual street illuminating power and that the minimum value should be 60 candles. It was therefore added that the illuminating power should be tested by horizontal measurements at the city's photometric stations or elsewhere.

A reduction from the rate of 29 dollars per lamp per year was to be made for whatever percentage the lamps in each district averaged below 60 candles. But when the tests came to be made it proved impracticable to remove the burner to a laboratory to test. They had therefore to be tested on the spot. Two plans were tried; one of these was to attach a photometer to the lamp-post and reflect the horizontal candle-power into the photometer by means of mirrors. A second method was to mount a laboratory photometer and bar with an automobile truck, which was carefully housed in with tarpaulins. On the basis of these tests the city deducted an amount of 53,000 dollars, proportional to the shortage in candle-power recorded.

The Company brought suit to recover this amount.

In the course of the evidence a great array of experts, including Dr. L. Bell, Mr. C. F. Lacombe, Mr. C. O. Bond, Mr. J. R. Cravath and others gave evidence. Eventually the case was decided in the favour of the Company.

COLOUR AND HEAT.

AN issue of the *Times* last year contained nearly a column devoted to the physiological effects of various kinds of light. Sunburn is said to be caused by the ultra violet rays of sunlight. But the visible rays have also an influence on us. The red rays are believed to be stimulating, while the blue have a sedative and even a depressing effect. Workers in rooms with red glass windows have been known to become excited, and a similar effect has been noted in small-pox patients submitted to red ray treatment. It is pointed out that these psychological effects have a distinct influence on the selection of colour. Red acts as a tonic, "is a whip to jaded nerves," blue light is soothing, and baths of light of this kind have been recommended in cases of over-excitement and neuralgia, &c.

Ultra violet rays in excess are bad to the skin, and sunburn following constant exposure is not necessarily an indication of health. On the other hand, such rays have a powerful germicidal action, and rooms into which the sun never shines are rightly suspected as being unhealthy.

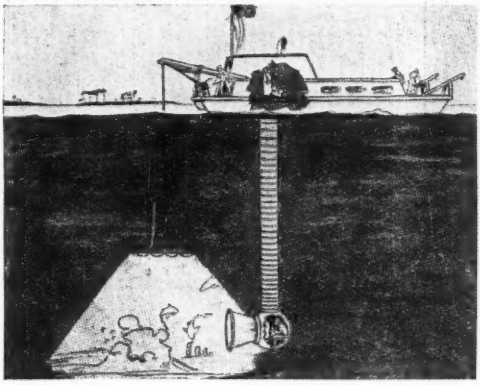
COLOURED LIGHT AND THE MODERN COMPOSER.

SCRIABINE, whose methods as a composer were extremely novel, proposed the combination of colour effects with his music.

He suggested altering the colour of the light in the auditorium according to the nature of the music, and was said to contemplate the evolution of a new form of colour music based on the projection on a screen of various constantly altering coloured designs. Some experiments in this direction were carried out by Mr. Wallace Rimington many years ago; the idea being that by projecting coloured patterns of varying form and intensity on a screen it should be possible to form subtle colour harmonies which appeal to the eye in much the same way as an intricate musical piece appeals to the ear.

SUBMARINE PHOTOGRAPHY BY AID OF A QUARTZ MERCURY LAMP.

THE illustration shows an interesting development of submarine photography which was recently described in the *Electrical Review and Western Electrician*.* The area to be photographed is illuminated by a battery of nine 2400 candle power quartz mercury vapour lamps.



The photographer is lowered to the requisite distance by means of a telescopic tube, which expands into a chamber about 5 feet in diameter. One side of this chamber is provided with a glass observation window, from which the pictures are taken. The chamber will contain two men, and a constant supply of fresh air is admitted from above.

It is stated that the American inventors of this apparatus (Mr. C. Williamson and his two sons, of Norfolk, Va.), claim to be able to take moving pictures at a distance of 100 feet. This appears to be a remarkable result, and leads one to wonder whether the illumination of distant objects under water by a searchlight beam is such an impossible process as is generally supposed. At the present time, when submarine warfare has made such great progress, the question is certainly an interesting one.

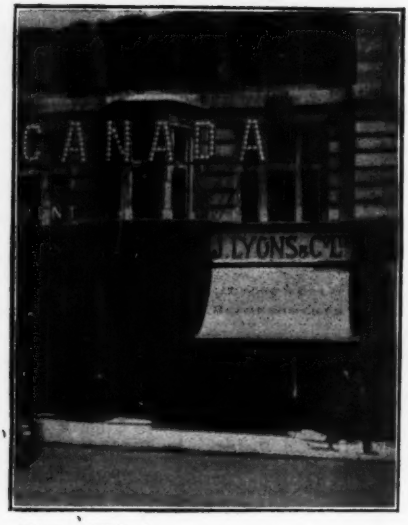
* May 29th, 1915.

"MATCHING THE SNOW."

IT has often been asserted that the German greenish-grey uniforms are specially adapted to render the troops difficult to distinguish against an ordinary background of trees and grass. On the other hand, the fact that colours in nature are constantly changing makes it difficult to secure these conditions permanently; one would imagine, for example, that the khaki of the British troops might be preferable in autumn when the prevailing tints are brown and yellow. Naturally the same holds good in the desert and in sandy plains.

The Germans are said to have made preparations for the winter campaign in Poland by ordering coats of the lightest possible shade to match the snow. Presumably when the spring came they reverted to the ordinary colours. This chameleon-like change of tint according to environment is surely a new thing in warfare.

Other instances of this mimicry of Nature are provided by the operations in the Dardanelles, in British East Africa, and on the Italian frontier. It is stated that the Alpini on reaching the snow line put on white garments over their tunics. In British East Africa some of the horses are striped like zebras, which renders them difficult to distinguish at a distance. In the Dardanelles the Turks concealed amidst the foliage are said to have adopted the practice of painting their hands and faces green!



A DAYLIGHT SIGN.

This type of sign has been described in THE ILLUMINATING ENGINEER in connection with signals for aircraft.* Each letter is made up of silvered hemispheres which catch the light and appear very brilliant objects in the sunshine.

The sign "Canada" is a prominent object in Whitehall (London).

* Vol. V., 1912, p. 395.

SIGNS AT RAILWAY TERMINI.

At main railway stations in London flame arc lamps have for some years been used to illuminate signs indicating the approach to the various tube-connections.

The arc is hung within a square composed of translucent glass and the illumination is strong enough to render the sign quite a conspicuous object.

ILLUMINATING ENGINEERING SOCIETY, U.S.A.

CHANGES IN THE CONSTITUTION ADOPTED.

AT the recent election of the Illuminating Engineering Society in the United States, Dr. C. P. Steinmetz was elected President, Mr. L. B. Marks, Treasurer, and Mr. A. S. Miller, General Secretary.

We observe that the proposals to amend the Constitution of the Society have been adopted by a vote of more than six to one. It will be recalled that these proposals involved the division of members into two classes, known respectively as "members" and "associate members" and paying respectively ten dollars and five dollars per annum. No doubt this step will considerably increase the revenue of the Society.

REVIEWS OF BOOKS AND PUBLICATIONS RECEIVED.

An Introduction to the Study of Colour Vision. By J. Herbert Parsons, D.Sc., F.R.S. (*Cambridge University Press*, 1915; 308 *pages*, 75 *illustrations.*)

THE study of photometry and illumination has brought home to many of us the complexity of the human eye, especially in regard to the perception of colour. It is impossible to enter deeply into these subjects without acquiring some acquaintance with physiological optics. But the more one learns the more one recognises the spreading vastness of this field of knowledge and the difficulty of keeping abreast of the recent advances in research. The old landmarks are changing and the subject is in a constant state of flux. Moreover, some of the most important of these researches appear in abstruse transactions of foreign societies such as are not readily accessible to the ordinary reader.

An up-to-date treatise placing this information at the disposal of British readers is therefore most welcome. Mr. Parsons reveals a deep knowledge of the subject, and has succeeded in dealing with the complex problems of Colour Vision in a concise and lucid manner.

The book is divided into three parts dealing respectively with "The Chief Facts of Normal Colour Vision," "The Chief Facts of Colour Blindness," and "The Chief Theories of Colour Vision." In the first section the author makes frequent reference to the work of Abney, König, von Kries, McDougall, and many other well-known authorities. After a brief descriptive analysis of the physical, anatomical, and psychological bases of vision, the author discusses the luminosity of the spectrum, the effects of adaptation of the eye to darkness and brightness, and the effect of receiving the luminous image on different regions of the retina. Subsequently there is an account of such phenomena as recurrent vision, flicker, the production of after-images, and the effects of fatigue—all matters which have an indirect bearing on photometry and illumination. Mr. Parsons, as one would expect from a Vice-President of the Illuminating Engineering Society, is familiar with recent work on flicker photometry and refers to some of the experiments carried out by photometrical experts in this country and in the United States. Very interesting is the account of the sense of colour possessed by various birds and reptiles, and the experiments that have been made on dogs and other animals. The section is completed by two chapters on the colour vision of primitive races and the colour vision of the child.

In Part 2 the author discusses the highly complicated problems of colour blindness and again gives an excellent series of references.

Part 3, devoted to theories of colour, contains matter which will be new to many readers. After dealing with the well-known Young-Hellmholtz and Hering theories, the author gives a brief summary of the more modern developments due to Donders, McDougall, Edridge-Green, and others—developments which are only now becoming known among physicists.

The reader cannot fail to be struck by the extreme difficulty of framing a comprehensive variety of colour vision and the complexity of the effects to be accounted for.

The book contains evidence of the vast amount of work that has been done on this subject, and should be of interest to many workers in other fields, besides those directly concerned with the study of colour vision.

The Bye-Products of Coal Gas Manufacture. By K. R. Lange. Translated from the German by Chas. Salter. (Scott Greenwood and Son, 1915; 155 pages, 13 illustrations.)

AT the present moment, when the public have been forcibly reminded of the development of the coal tar industry abroad, this little volume should be welcome. The first portion of the book is devoted to an account of the composition of coal and the purification of coal gas. Subsequently the author goes on to explain the nature of gas tar and gas liquor and to describe their treatment in preparing various chemical substances. Besides this, the treatment of the gas purifying agents is of considerable importance, and it will come as a surprise to some readers to find how many are the chemical substances derived in this way.

Electric Light Fitting. By S. C. Batstone, A.M.I.E.E. (Whittaker and Co., London, 1914; 317 pages, 238 illustrations.)

IN the preface the author states that his chief aim is to confine himself entirely to "the practical side of the question," so that little is said as to the decorative aspects of lighting. The illustrations are clear and the book follows a well-ordered sequence. The initial chapter deals with simple laws and units of measurement, and subsequent sections of the book are devoted to conductors, conduits and casings, switches, holders and fittings, lamps, shades and reflectors, house wiring, private plants, meters, stoves, &c. The chapter on switches is comprehensive, and the diagrams descriptive of house-wiring are easy to follow. In the chapter on fittings and shades we should like to see a little more said as to their development with regard to illumination, particularly the design of prismatic and metal reflectors, with a view to concentrating and distributing the light on a pre-arranged plan. Some of the best types are not illustrated. We notice a slip on p. 169, where the French unit of light is spoken of as the "cared" (carcel ?): at the present time both Britain and France use the same so-called "international" candle.

OTHER PUBLICATIONS.

The Proceedings of the Physical Society, Vol. XXII., Part III., contains two interesting papers by Mr. C. C. Patesron and Mr. B. P. Dudding on "The Unit of Candlepower in White Light" and "The Estimation of High Temperatures by the Method of Colour Identity."

The Simple Character of of the Yellow Sensation. By F. W. Edridge-Green. (Reprinted from the Journal of Physiology, Vol. XLIX., No. 4, May 12th, 1915.)

Reprinted from the Transactions of the Illuminating Engineering Society, U.S.A.:—

Artificial Daylight, Its Production and Use. By M. Luckiesh and F. E. Cady.

The Application of the New High Efficiency Tungsten Lamp to Photography. By M. Luckiesh.

Safeguarding the Eyesight of School Children. By M. Luckiesh.

TOPICAL AND INDUSTRIAL SECTION.

[At the request of many of our readers we are again extending the space devoted to this Section, and are open to receive for publication particulars of interesting installations, new developments in lamps, fixtures, and all kinds of apparatus connected with illumination.

The contents of these pages, in which is included information supplied by the makers, will, it is hoped, serve as a guide to recent commercial developments, and we welcome the receipt of all *bona-fide* information relating thereto.]

SIEMENS BROS. DYNAMO WORKS, LIMITED.

Note New Address for Sales and Advertising Department.

The Sales and Advertising Departments of Messrs. Siemens Brothers Dynamo Works Limited, Incandescent Lamp and Fittings department, Dalston, have recently been transferred to 39, Upper Thames Street, E.C. From this address the combined lamp and supplies business will in future be controlled. The re-arrangement has been made essential by the rapidly-increasing turnover of Wotan and Tantalum lamps. Extensions in the manufacturing departments have been accomplished from time to time, and it will be remembered that exceptionally large premises at Shacklewell Lane were occupied some three years ago to provide store accommodation for the large stocks held by the Company. Although this released a certain amount of space and temporarily eased the situation, the introduction of new types of lamps, including gas-filled lamps, demanded that further extensions should be made. As a result, Dalston Works will now be devoted solely to lamp manufacture, and the output correspondingly increased. Apart from these considerations, it is hoped that the centralisation of the lamps and fittings selling organisations will prove to the convenience of their numerous customers.

All correspondence relating to Dalston material should be addressed to 39, Upper Thames Street, E.C.

CONTRACT ACCEPTED.

Messrs. Siemens Bros. Dynamo Works, Ltd., have received an acceptance of their tender for the supply of Wotan and Tantalum lamps from the Pontypridd U.D.C. for the ensuing twelve months.

"EDISWAN" KINGOLITE CANDLE LAMPS.

We are informed that the Kingolite Co., Ltd., of Pyke House, 19, 21, 23, Oxford Street, and Soho Square, W. (of which Mr. William J. Owen is Managing Director), have disposed of their business in electrical accessories and silk shades to the Edison & Swan United Electric Light Co., Ltd.

The Kingolite Co.'s Works, together with practically the whole staff, have been transferred to Ponders End, while Mr. Owen, having accepted a position with the Edison & Swan United Electric Light Co., Ltd., continues to superintend the business he has been instrumental in establishing.

SHOOTING COMPETITION BETWEEN TWO LEADING ELECTRICAL FIRMS.

A friendly shoot between the "Ediswan" Rifle Club and a team from Siemens Rifle Club was decided on the "Ediswan" Range last Saturday, June 26th. There was a very good muster, and many well-known names in the electrical field were present.

Siemens put 17 men in the field, including Mr. Holmes (Sales Manager), Mr. Hicks (Assistant Sales Manager), and Mr. Pryor (Hon. Secretary to the Club).

"Ediswan" team were equal in number, and included Messrs. Child and Elliott (Joint Sales Managers) and Mr. Corbett (Hon. Secretary).

The shoot resulted in a win for the home team by 1,284 to 973.

After the shoot the party, of nearly 50, adjourned to the Staff Café for tea, and a vote of thanks to the hosts was proposed by Mr. Holmes, and responded to by Mr. Elliott, after which the latter presented the prizes.

Having taken tea, another match, of six a side, was decided in favour of the "Ediswan" men, by 518 to 492.

YE OLD MITRE TAVERN.

YE Old Mitre Tavern in Ely Place, near Holborn, is one of the oldest taverns of London, though, strange to say, it is not often mentioned by antiquarians.

It stands on the site of the Bishop of Ely's garden, which was demolished in 1545, and the tavern actually dates back to 1546. One curious feature is a tree trunk, which supports one corner of the building, and may be seen from the outside. It is said to be the remains of a fruit tree which actually stood once in the Bishop's garden.

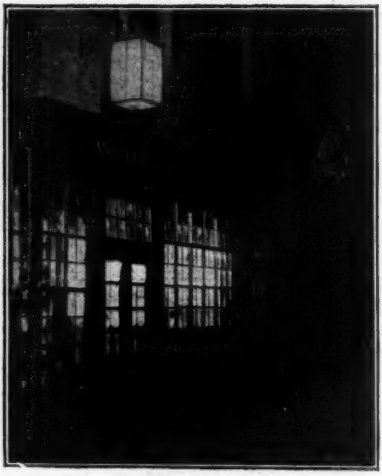


FIG. 1.—An exterior view of the Tavern taken entirely by artificial light. Note the antique form of lantern.

A curious circumstance is that the space immediately adjacent to Ely Place, in which the tavern stands, still remains in the diocese of Ely. We believe we are correct in stating that no rates are paid to the authorities in London, and that all payments are made direct to the Ecclesiastical Commissioners in Ely. In a sense, therefore, the neighbourhood forms part of the County of Cambridgeshire and not the County of London. We understand that the City Police do not enter this area unless specifically requested to do so, and their duties are mainly exercised by the beadle, appointed from Ely, who carries out the functions of the old night watchman, making his rounds at intervals during the night and calling out the hour.

The building has lately been restored, and particular care has been taken by the architect, Mr. W. F. Foster, M.S.A., P.A.S.I., M.R.S.I., to retain the period. From the lighting standpoint the attention paid to the fixtures is interesting. The lantern shown in the foreground was specially designed to the correct style, and the oak panelling, furniture and lighting fittings in the interior have also been designed to special care. Attention may be drawn to the old oak chairs and tables and the iron work of the grate which is strictly true to period.

The curious chandelier hanging from the beams of the ceiling has also been specially designed to imitate the old conditions. The electric candles are mounted at the four corners of a massive wooden cross carried on a heavy chain and hook. The only somewhat incongruous element is the fact of electric candles being used, but in these modern times it is not in human nature to retain waxed candles! We may mention that the contractors responsible for carrying out the lighting were Messrs. Grant & Taylor, of Queen Victoria Street.

The two photographs reproduced herewith were taken entirely by artificial light, and the subject is certainly a

FIG. 2.—Interior view in Ye Old Mitre Tavern. The furniture, chandelier, and ironwork in grate have been specially designed to suit the period.

difficult one. At one stage in the proceedings an overcoat was hung over a powerful public light in the foreground, the presence of which threatened to prejudice the result owing to the long exposure. In the circumstances the photographs may be considered very satisfactory.

THE MOORE LIGHT IN SPAIN.

A BOOKLET issued by the **Luz Moore Artigas C.A.** (Madrid) summarises the operations of this company in Spain. The booklet contains a variety of illustrations showing the application of the Moore Light for spectacular lighting outside shops, in factories and in the Royal Palace at Madrid. In the accompanying two illustrations we reproduce two of the most interesting of these views. Fig. 1 shows the reception room in the Palace illuminated by a pattern of Moore tubes on the ceiling, Fig. 2 the use of system in the form of indirect cornice lighting in a room with several handsome pictures.

Particulars are also given of several notable improvements in the Moore tube. One of these is the invention of an apparatus for locating small leakages in the tube, which, it is stated, can now be detected immediately, whereas previously six or seven days' delay would often be necessary.

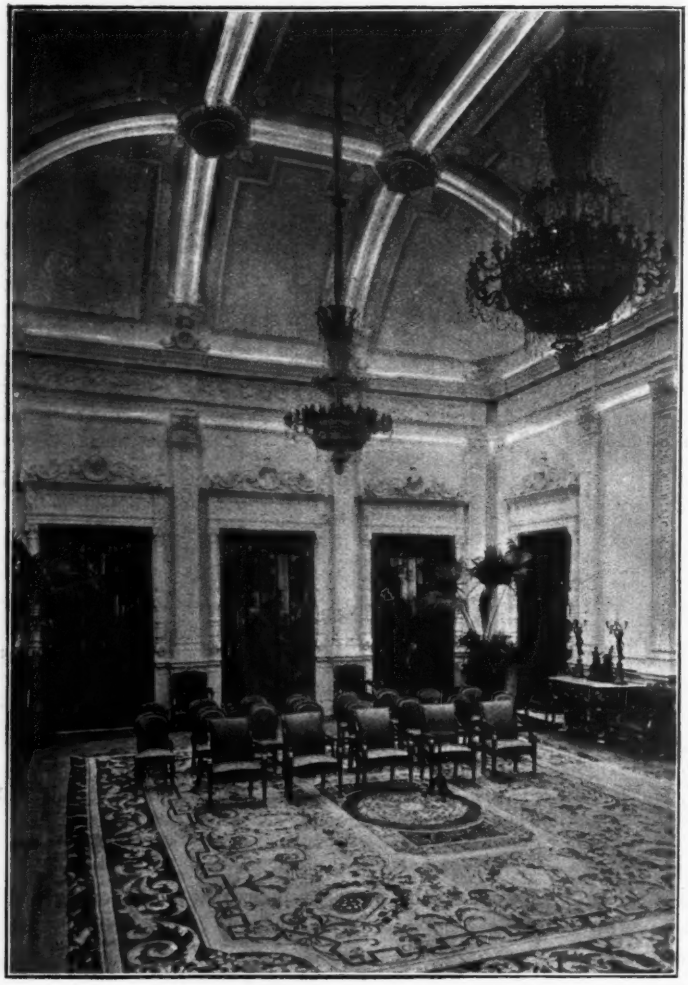


FIG. 1.—Reception Room of the Royal Palace, Madrid, lighted by Moore Tube on ceiling.

FIG. 2.—Indirect Cornice Lighting with the Moore Tube (Royal Palace, Madrid).

The second discovery is the doing away of the gas compressor feeding the tube, which has hitherto considerably limited the scope of operation of the system.

Yet another invention involves the superimposing of a high harmonic discharge over the ordinary alternating P.D., by which means the colour of the light can be considerably modified and much more efficient results secured. As a result of this method tubes of any convenient size and dimensions can be used, whereas a diameter of 45 millimetres was previously necessary. Letter-signs of all kinds can now be made, and tubes of low consumption are available. Finally, by the use of the rarer gases, it is possible to avoid to a great extent the catalytic absorption of gases by the electrodes and to secure a specific consumption of only one-third of that previously attained.

Half-Watt Lamps.

New Types and Reduced Prices.

Recent leaflets received from the chief lamp-makers contain particulars of a variety of half-watt lamps. It is interesting to note the different methods of arranging the filament now in vogue. New sizes of the lamps are available, and prices have been reduced. We note that 60-watt lamps can now be had for pressures from 100 to 130-volt and 100-watt lamps for 200 to 260 volt circuits.

Osram Atmos Lamps.

The General Electric Co., Ltd., send us a new leaflet descriptive of the Osram half-watt lamps, or, as they will in future be termed, "Osram Atmos Type Lamps." There is much to be said for the policy of calling such lamps by a name descriptive of their special manufacture, rather than their specific consumption. In the United States they are spoken of as "gas-filled" lamps.

Rise in Price of Glassware.

Messrs. Siemens Bros. Dynamo Works, Ltd., inform us that since June 1st, 1915, it has been found necessary to advance the list prices of fittings and glass ware by 10 per cent.

Ediswan Electric Service.

The Edison & Swan United Electric Light Co. have sent us a copy of the second issue of their booklet bearing the above title. The booklet contains a readable account of various Ediswan novelties, such as Dimmer Switches, Fans, Lighting Fittings, &c.

An amusing incident—the arrest of one of the staff who had arranged to take a photograph of the New Glass House—is mentioned. The best of the joke was, that the arrest was made on the information of another employee on the look-out for spies. Needless to say, the photographer was soon identified and released, and, in the words of the article, "an entente cordiale" between the prisoner and the constables was established.

The G.P.O. has accepted the tender for a six months supply of "Royal Ediswan" (Tungsten) Drawn Wire lamps.

THE SOCIETY OF BRITISH GAS INDUSTRIES.

At the Annual Meeting of the Society of British Gas Industries in March, Alderman F. Templer Depree, the Chairman of the Council, gave an interesting account of the activities of the Society during the past ten years.

The movement dates from December, 1904, when a suggestion was thrown out in a leading article in the *Journal of Gas Lighting*, and taken up by Mr. Charles Clare. The central idea was to form a closer association between the engineers who produce the gas and the men who arrange for its distribution and use. The first meeting of the Society took place in March, 1906. Alderman Dupree referred to the series of distinguished Presidents from Mr. Dugald Clerk, F.R.S., to Sir Alfred Keogh, K.C.B., LL.D. An interesting analysis of the progress in the industry during these ten years was also made. One of the most striking episodes has been the rise of high-pressure gas lighting, but in the manufacture of gas, and in its use for heating and cooking, there have also been great strides.

At the present time the question of coal-tar dyestuffs fills an important place. The review concluded with a comparison of the make of the chief gas companies in 1904-5 and 1914-15. The outputs in cubic feet of the two largest concerns are as follows:—

	1904-5.	1914-15.
Gas Light and Coke Co.	21,902,357,000	29,633,586,000
South Metropolitan Gas. Co.	12,219,174,000	14,097,252,000

THE LIGHTING OF THE FINSBURY PARK EMPIRE.

Auditorium (ceiling) lighting of the Finsbury Park Empire.
(Proprietors : Moss' Empires, Ltd.)

In a modern Music Hall or Cinematograph Theatre light plays an important part. The stage, being the central point of interest, must be more brightly lighted than the auditorium ; in a Cinematograph Theatre, particularly, where the lights are turned on and off at such frequent intervals, the method of gradually diminishing the illumination desires special attention, and suitable " dimmers " are now almost invariably used.

The Finsbury Park Empire is lighted throughout with Mazda Lamps and B.T.H. Veluria reflectors. As will be seen from the above illustration, the ceiling carries a series of chandeliers thus equipped. The lighting units, softened as they are, are out of the direct range of view, and the effect is considered very pleasant. Further particulars of Mazda Lamps and Veluria Glassware can be obtained on application from The British Thomson-Houston Co., 77, Upper Thames Street, London, E.C.

GLASGOW SMOKE ABATEMENT EXHIBITION.

To take place in the Exhibition Hall, New City Road, Glasgow, from Thursday, Sept. 23rd—Sat. Oct. 16th, 1915.

This coming Exhibition is the third of its kind held at Glasgow, and on the last occasion no fewer than a hundredthousand visitors passed through the turn-stiles.

The forthcoming Exhibition will be under the patronage of the Glasgow Corporation and the local branch of the Smoke Abatement League. There will be exhibits of apparatus for heating, lighting, and cooking without smoke, and gas and electric current will be supplied to exhibitors free of charge. Lectures and demonstrations will be given daily.

Those interested should apply to the Manager, Mr. James M. Freer, 38, Bath Street, Glasgow.

OUR BLINDED SOLDIERS AND SAILORS.

The National Institute of the Blind, which has already done so much for the sightless in peace time, recently placed at the disposal of blinded soldiers and sailors a Convalescent Home at Brighton, where they are sent for any rest or change during their period of training at St. Dunstan's Hostel, in Regent's Park.

Here blinded soldiers are taught Braille reading, writing, typewriting, &c., and are even trained in such occupations as carpentry, boot-repairing, massage and telephony. An attractive little booklet shows how the soldiers are helped to indulge in such recreations as boating on the lake.

We feel sure that all our readers will appreciate the splendid work that the Institute is doing, and sympathetically regard the appeal for help now being issued by the President and Hon. Treasurer, Mr. C. Arthur Pearson, Further particulars can be obtained on application to the National Institute for the Blind, 224-8 Gt. Portland St., London, W.

PERSONAL.

We regret to hear that Mr. Ralph P. Hulton, who was formerly North Country representative of Holophane, Ltd., has succumbed to wounds received in the operations in the Dardanelles. Immediately after the outbreak of war Mr. Hulton enlisted in the Engineer Section of the Royal Naval Division.

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We note that Mr. Eric. D. Stokes, son of the Chief Inspector of the South Metropolitan Gas Co., who is also known to readers as a Member of Council of The Illuminating Engineering Society, has been granted a commission as Second Lieutenant in the 3rd Battalion of the 6th City of London Rifles.

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RAILWAY CARRIAGE LIGHTING.

In view of the great amount of attention which the subject of the correct illumination of railway carriages has recently been receiving at the hands of the lighting engineers of railway companies and others, the accompanying illustration, which we have received from Holophane, Ltd., is of interest.

This railway carriage is one of a large number built by the Metropolitan Carriage Wagon & Finance Co., Ltd., at Saltley, Birmingham, for the Central Argentine Railway.

The overall dimensions of the carriage are approximately 66 ft. by 9 ft. It is divided into two compartments, each 25 ft. by 9 ft., and both compartments are installed with four 12-in. Holophane Reflector Bowls (each equipped with two 40-watt lamps) down the centre of the coach, whilst on either side there are four Holophane Pines No. 3150 with 40-watt lamps.

The energy provided in this case is very liberal, enabling an illumination intensity of 6 foot-candles to be obtained uniformly over the whole reading plane. It is also stated that the soft and well-diffused lighting prevents any impression of glare—a point on which much emphasis was placed in a recent discussion on the subject at a meeting of the Illuminating Engineering Society.